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NATIONAL DAM SAFETY PROGRAM. OSWALD DAM (MO 11031), MISSOURI - --ETC(U)
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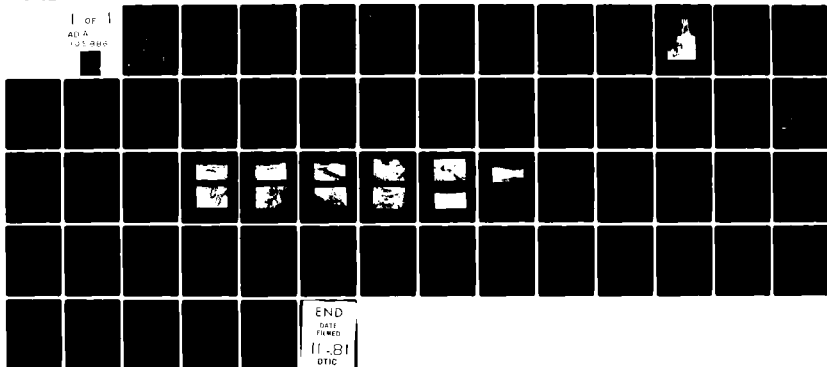
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MISSOURI-NEMAHA-NODAWAY BASIN

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OSWALD DAM

ATCHISON COUNTY, MISSOURI

MO. 11031

**PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM**



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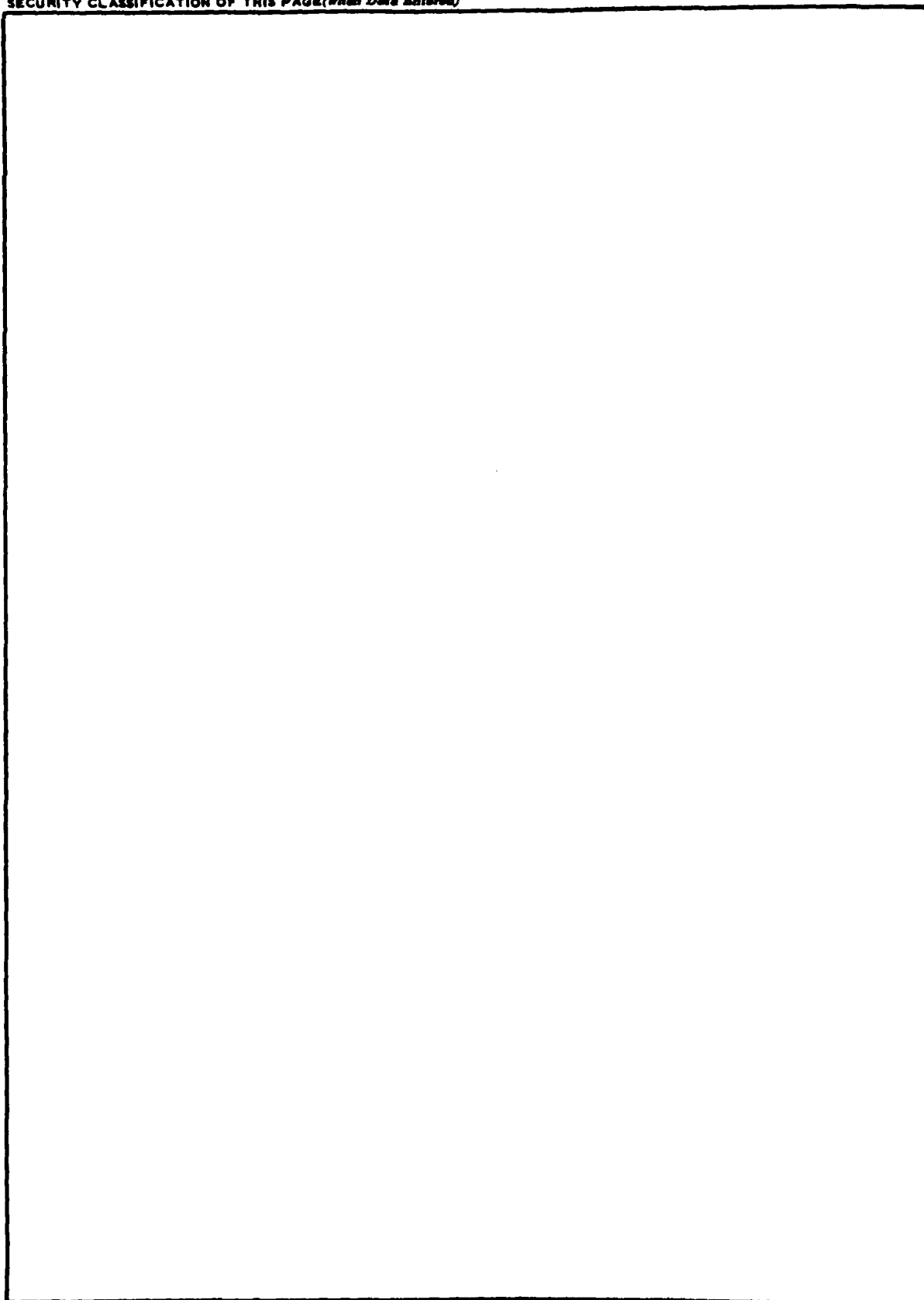
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OSWALD DAM
ATCHISON COUNTY, MISSOURI
MO. 11031

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY
HOSKINS-WESTERN-SONDEREGGER, INC.
CONSULTING ENGINEERS
LINCOLN, NEBRASKA

UNDER DIRECTION OF
ST. LOUIS DISTRICT, CORPS OF ENGINEERS

FOR
GOVERNOR OF MISSOURI
MAY, 1979

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Oswald Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Oswald Dam:

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

- 1) Spillway will not pass 50 percent of the Probable Maximum Flood.
- 2) Overtopping could result in dam failure.
- 3) Dam failure significantly increases the hazard to loss of life downstream.

SIGNED

SUBMITTED BY _____
Chief, Engineering Division

25 SEP 1979
Date

SIGNED

APPROVED: _____
Colonel, CE, District Engineer

25 SEP 1979
Date

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam	Oswald Dam
State Located	Missouri
County Located	Atchison County
Stream	Tributary to Rock Creek
Date of Inspection	May 14, 1979

Oswald Dam was inspected by an interdisciplinary team of engineers from Hoskins-Western-Sonderregger, Inc. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as a small size dam with a high downstream hazard potential. Failure would threaten life and property. The estimated damage zone extends approximately 2.5 miles downstream of the dam. Ten buildings in the town of Rock Port, three county roads, and U.S. Highway 136 are within this zone.

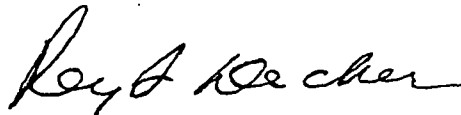
Our inspection and evaluation indicates that the spillway does not meet the criteria set forth in the recommended guidelines for a small dam having a high hazard potential. Considering the volume of water impounded and the large floodplain of Rock Creek approximately 1 mile downstream of the dam, one-half of the Probable Maximum Flood is the appropriate spillway design flood. The spillways will not pass the 100-year flood (flood having a one percent chance of being exceeded in any year) without overtopping the dam. The spillways will pass 13% of the Probable Maximum Flood without overtopping the dam. The Probable Maximum Flood (PMF) is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

No design data were available for this dam. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These analyses should be obtained in the future.

Other deficiencies observed during the inspection are small trees growing along the waterline on the upstream slope, rodent holes in the upstream slope, minor erosion of upstream slope along waterline, gully erosion on the right abutment trough, tree growth on downstream slope and along the toe of the dam, seepage outcrops in the left abutment trough, seepage and slumping of embankment around the left side of the principal spillway outlet, slumping and caving of the left abutment, seepage at the base of the slumps in the left abutment, no trash rack on the inlet to the principal spillway, erosion of the fill covering the spillway inlet, a large sink hole in the entrance channel of the left emergency spillway, considerable erosion around the reservoir shoreline, downstream channel badly choked with trees and brush, and the principal spillway scour hole is eroding and encroaching on the toe of the right abutment.

The growth of trees on the embankment slopes, the gullies in the right downstream abutment trough, the rodent holes in the upstream face, the sink hole in the left emergency spillway and the uncontrolled sluffing and sliding of the left downstream abutment indicate the lack of maintenance on this dam.

Maintenance and repair are urgently needed on this dam to prevent further deterioration and ultimate failure. These items should be pursued on a high priority basis. The items requiring maintenance and repair are described in detail in the report.



Rey S. Decker
E-3703


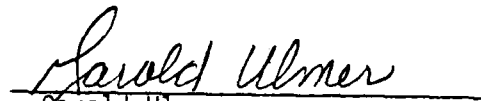
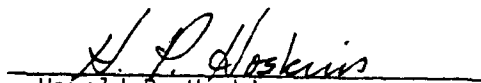

Gordon Jamison
Garold Ulmer
E-4777
Harold P. Hoskins
Chairman of Board
Hoskins-Western-Sonderegger, Inc.
E-8696



PHOTO NO. 1 - OVERVIEW TAKEN FROM LEFT ABUTMENT

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
OSWALD DAM - MO 11031
ATCHISON COUNTY, MISSOURI

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

- a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of Oswald Dam be made.
- b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.
- c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams", Appendix D to "Report of the Chief of Engineers on the National Program of Inspection of Dams", dated May, 1975, and published by the Department of the Army, Office of the Chief of Engineers.

1.2 DESCRIPTION OF PROJECT

- a. Description of Dam and Appurtenances.
 - (1) The dam is an earth fill structure approximately 155 feet long and 40 feet in height. It is located in a deeply incised gully in the deep loess hill country adjacent to the Missouri River Valley in northwestern Missouri.
 - (2) The principal spillway consists of a 24-inch diameter steel pipe with a hood inlet which passes through the embankment on an angle of about 30° to the centerline of the dam.
 - (3) A vegetated earth emergency spillway is cut through the abutment on the left (north) end of the dam. The bottom width of the spillway is 25 feet ±.

- (4) A vegetated earth emergency spillway is cut through the abutment on the right (south) end of the dam. The bottom width of the spillway is 20 feet±.
- (5) Pertinent physical data are given in paragraph 1.3 below.
- b. Location. The dam is located in the northwestern portion of Atchison County, Missouri, as shown on Plate A-2. The dam is shown on Plate A-1 in the SE¼ of Section 16, T65N, R41W. The lake formed behind the dam is shown in the E½ of Section 16, T65N, R41W.
- c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, this dam and impoundment is in the small size category.
- d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph 1.1c above. Based on referenced guidelines, this dam is in the High Hazard Classification. The estimated damage zone extends approximately 2.5 miles downstream of the dam. Ten buildings in the town of Rock Port, three county roads and U.S. Highway 136 are within this zone.
- e. Ownership. The dam is owned by Mrs. Paul Oswald, Route 1, Box 252, Rock Port, Missouri 64482.
- f. Purpose of Dam. The purpose of the dam is for erosion (gully) control.
- g. Design and Construction History. No design or construction data were available for this dam. It was reported by Mrs. Ronald Sutter, who lives 1/4 mile north of dam site, that the dam was constructed 10 to 15 years ago.
- h. Normal Operating Procedure. There are no controlled outlets for this dam.

1.3 PERTINENT DATA

- a. Drainage Area. 507 acres (0.79 square miles).
- b. Discharge at Damsite.
 - (1) All discharges at the damsite are through a 24 inch diameter steel pipe with hooded inlet (principal

spillway) and through ungated, uncontrolled grassed earth channels (emergency spillways) located in the left and right abutments.

- (2) Estimated maximum flood - unknown.
- (3) The principal spillway capacity varies from 0 cfs at elevation 1004.6 feet to 37 cfs at elevation 1013.3 feet (right emergency spillway crest) to 41 cfs at elevation 1015.6 feet (minimum top of dam).
- (4) The emergency spillway capacity for the right abutment varies from 0 cfs at its crest elevation 1013.3 feet to 157 cfs at elevation 1015.6 feet (minimum top of dam). The emergency spillway capacity for the left abutment varies from 0 cfs at its crest elevation 1014.6 feet to 54 cfs at elevation 1015.6 feet (minimum top of dam).
- (5) Total spillway capacity at the minimum top of dam is 252 cfs \pm .

c. Elevations. (Feet above M.S.L.)

- (1) Top of dam - 1016 \pm
- (2) Principal spillway crest - 1004.6 \pm
- (3) Emergency spillway crest - 1014.6 \pm (left) - 1013.3 \pm (right)
- (4) Streambed at centerline - 976 \pm
- (5) Maximum tailwater - unknown

d. Reservoir. Length (feet) of maximum pool - 1,750 \pm

e. Storage (Acre-feet).

- (1) Top of dam - 92 \pm
- (2) Principal spillway crest - 10 \pm

f. Reservoir Surface (Acres).

- (1) Top of dam - 14 \pm
- (2) Principal spillway crest - 5 \pm

g. Dam.

- (1) Type - earth fill
- (2) Length - 155 feet \pm
- (3) Height - 40 feet \pm

- (4) Top width - 16 feet
- (5) Side Slopes.
 - (a) Downstream - 1.7 H on 1V (upper one-half)
3H on 1V (lower one-half) measured
 - (b) Upstream - 3.2H on 1V (measured)
- (6) Zoning - unknown
- (7) Impervious core - unknown
- (8) Cutoff - unknown
- (9) Grout curtain - unknown
- (10) Wave protection - none

h. Diversion Channel and Regulating Tunnel. None

i. Spillway.

(1) Principal

- (a) Type - 24 inch diameter steel pipe with hooded inlet
- (b) Crest (invert) elevation - 1004.6 feet ±
Outlet - 979.4 feet ±
- (c) Length - 150 feet ±

(2) Emergency

- (a) Type - vegetated earth spillways on both ends of the dam
- (b) Control section - Left (north) end = 25 feet wide;
Right (south) end = 20 feet ± wide
- (c) Crest elevation - Left = 1014.6 feet ±; Right = 1013.3 feet ±
- (d) Upstream Channel - both channels are open and vegetated
- (e) Downstream Channel - Left channel is open and vegetated. Right channel exits onto cultivated field and into a small farm pond in adjacent gully.

j. Regulating Outlets. None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were available for this dam.

2.2 CONSTRUCTION

No construction data were available. It was reported by Mrs. Ronald Sutter, who lives 1/4 mile north of dam site, that the dam was constructed 10 to 15 year ago.

2.3 OPERATION

No data were available on spillway operation.

2.4 EVALUATION

- a. Availability. No data were available.
- b. Adequacy. The field surveys and visual observations presented herein are considered adequate to support the conclusion of this report. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.
- c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

- a. General. A visual inspection of the Oswald Dam was made on May 14, 1979. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska making the inspection were: Rey S. Decker, Geotechnical; Gordon Jamison, Hydrology; and Garold Ulmer, Civil Engineer. The owner was not present during the inspection.
- b. Dam.
 - (1) Geology and Soils (abutment and embankment). The dam is located in a deeply incised gully in the deep loess hill country adjacent to the Missouri River. The abutment materials consist of CL-ML loess overlying glacial till; however, no till outcrops were observed at this site. Materials in the dam consist of CL-ML soils derived from loessal deposits on the abutments and in the valley bottom.
 - (2) Upstream Slope. The upstream slope is well vegetated with adapted grasses. Several small trees are growing along the waterline. Several rodent holes, up to 8 inches in diameter, were observed left of the principal spillway inlet and about one-half way between the waterline and crest of the dam (see photo 4, Appendix B). Some minor erosion was noted along the waterline. No cracks, slumps or abnormal deformations were noted.
 - (3) Crest. The crest is well vegetated with adapted grasses. No cracks, potholes or small depressions were observed on the crowned crest. Measurements along the crest indicate that the crest elevation on the right end is slightly higher (0.6 feet) than the left end. No cracks were observed on the crest and the slightly uneven profile is probably "as constructed".
 - (4) Downstream Slope. The downstream slope is well vegetated with adapted grasses. However, some surface runoff gullies, up to 2 to 3 feet in depth, were noted in the right abutment trough (see Photo 11, Appendix B). Several locust and other trees are growing on the slope and along the toe of the slope. Seepage outcrops were observed along the toe of the dam in the left abutment trough from about elevation 996, which is about one-half way between the crest and water surface in the channel,

down to elevation 980 \pm , the old alluvial bottom (downstream from about $\frac{1}{2}$ Stations 1+40 to 2+00). Seepage and slumping was observed around the left side of the principal spillway outlet. Seepage effluent was all clear and total discharge was estimated at 0.25 to 0.5 gals./min. The left abutment has slumped and caved leaving almost vertical scarps 4 to 6 feet high for a distance of 50 to 75 feet downstream from the dam. Seepage is evident at the base of these slumps and it appears that this action has been progressing for several years.

- (5) Miscellaneous. Materials in the abutments are highly erosive and have low apparent shear strength when saturated, which are natural characteristics of deep loess deposits in this area. Materials observed on the embankment were CL-ML soils. It is doubtful that this dam would withstand overtopping without serious damage or potential of failure.

c. Appurtenant Structures.

- (1) The principal spillway consists of a 24 inch diameter steel pipe, with hooded inlet, which crosses the centerline of the dam from opposite about $\frac{1}{2}$ Station 2+62 upstream to 1+94 downstream. The pipe passes through the embankment from inlet elevation of about 1004.6 feet to outlet elevation of 979.4 feet. No trash rack was observed on the inlet to the pipe and some erosion was noted in the fill covering the inlet end of the pipe. No deterioration of the pipe was observed. At the time of inspection the reservoir level was slightly below the invert of the pipe.
- (2) The emergency spillway system consists of channels, excavated or natural, at both ends of the dam. It appears that the left channel was excavated through the abutment. The left spillway exits down the left abutment-embankment trough. It is not known whether the right channel was excavated or the embankment constructed above natural ground level. The right channel has a bottom width of 20 feet \pm and is more than 1 foot lower than the left channel. A wood and wire fence crosses the right spillway channel just upstream from $\frac{1}{2}$ of the dam. The left spillway channel has a bottom width of 25 feet \pm . A large sink hole is located near the center of the entrance channel for the left spillway (see Photo 3). The hole is located at about elevation

1010 which is about the observed high water elevation of the reservoir. The exit channel for the right channel (spillway) flows into a small farm pond located 150 feet± southeast of the dam.

(3) Drawdown Facilities. There are no evident drawdown facilities for this dam.

- d. Reservoir Area. There is considerable erosion around the reservoir shoreline, particularly in the areas where old gullies and headcuts have been blocked by the lake. There are many dead trees along the shoreline.
- e. Downstream Channel. The downstream channel is badly choked with trees and brush, alive and dead. The principal spillway scour hole is eroding and encroaching on the toe of the right abutment. Underscour of the principal spillway is occurring.

3.2 EVALUATION

Seepage on the downstream slope and in the left abutment trough is outcropping at about the elevation of the theoretical phreatic surface. This factor combined with the steepness of the downstream slope and the apparent nature of the materials in the embankment indicate that this dam would not have adequate safety against shear failures under maximum loading conditions. The rodent holes on the upstream face of the dam could cause a potential of failure by piping under full reservoir head. Any significant flow through the left emergency spillway could cause serious erosion of the abutment and toe of the embankment. The fence across the right emergency spillway channel would impair the function of this spillway. Trees growing on the upstream and downstream slopes of the dam could cause potential of failure unless removed and treated.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no controlled outlet works for this dam. The pool level is controlled by rainfall, evaporation, and the capacity of the uncontrolled spillways.

4.2 MAINTENANCE OF DAM

The growth of trees on the embankment slopes, gullies in the right downstream trough, the rodent holes on the upstream face and the uncontrolled sluffing and sliding of the left downstream abutment indicate the lack of maintenance on this structure.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect for this dam.

4.5 EVALUATION

There appears to be a potential of failure of this structure. Seepage combined with the steepness of the downstream slope and the apparent nature of the materials in the embankment indicate that this dam would not have adequate safety against shear failures under maximum loading conditions. Potential of failure by piping under full reservoir head is enhanced by the presence of rodent holes, the sink hole and surface gullies. Significant flows through the left emergency spillway could cause potential failure by breaching the dam.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

- a. Design Data. No design data were found for this dam. All computations are based on the field inspection and survey performed during the inspection. The plans, profiles, and cross sections from the survey are attached in Appendix C.
- b. Experience Data. The drainage area, reservoir surface area, and elevation-storage data were developed from the USGS Nemaha Nebraska - Missouri 15 minute topographic quadrangle maps. The hydraulic computations for the spillway and dam overtopping discharge ratings were based on data collected in the field at the time of the field inspection.
- c. Visual Observations.
 - (1) The spillway pipe appeared to be in good condition. No trash rack was observed on the hooded inlet.
 - (2) The principal spillway discharges into the old stream channel. The principal spillway scour hole is eroding and encroaching on the toe of the right abutment. The downstream channel is badly choked with trees and brush.
 - (3) Emergency spillways are located at both ends of the dam.
 - (4) The left emergency spillway was excavated through the left abutment. It is well grassed. A sink hole is located in the spillway entrance.
 - (5) Spillway releases from the left emergency spillway flow down the left abutment trough into the old stream channel. Spillway use could possibly endanger the integrity of the dam.
 - (6) The right emergency spillway appears to be natural ground with the dam embankment constructed above it. It is approximately 1 foot lower than the left spillway channel. A wooden and wire fence crosses the spillway just upstream of the centerline of the dam and would definitely impede any flow through the spillway.

- (7) Most of the spillway releases from the right emergency spillway flow across a cultivated field into a small farm pond located approximately 150 feet southeast of the dam. Some flow would, however, release down the right embankment trough.
- (8) No drawdown facilities are available to evacuate the pool.
- d. Overtopping Potential. The spillways are too small to pass 50% of the Probable Maximum Flood without overtopping. The 100-year (1 percent) Flood also overtops the dam at a depth of 0.4 feet for approximately 1 hour. The spillways will pass 13% of the PMF and the 10-year (10 percent) Flood. The 10-year peak outflow discharge is approximately 30% of the spillway capacity. It is doubtful that this dam would withstand any sustained flow from overtopping without serious damage or potential of failure.

The results of the routings through the dam are tabulated in regards to the following conditions.

Frequency	Inflow Discharge cfs	Outflow Discharge cfs	Maximum Pool Elevation	Freeboard Top of Dam Min. Elev. 1015.6 Ft.	Time Dam Overtopping Hr.
10 Yr.	1100	64	1014.3	+1.3	0
100 Yr.	1900	510	1016.1	-0.5	1+
1/2 PMF	3500	3100	1017.9	-2.3	6+
PMF	7000	6300	1019.4	-3.8	9±
0.13 PMF	875	252	1015.6	0	0

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, this dam is classified as having a high hazard rating and a small size. Therefore, the 1/2 PMF to the PMF is the test for the adequacy of the dam and its spillway.

The estimated damage zone is described in Paragraph 1.2d in this report.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

- a. Visual Observation. It is doubtful that this dam would have adequate safety against shear failures in the downstream section under full loading conditions. This conclusion is based upon the apparent development of an uncontrolled phreatic surface through the embankment under normal pool conditions, steepness of the downstream slope for a dam of this height and the apparent nature of the materials in the dam. Rodent holes, the sink hole and root holes into the embankment would decrease the length of seepage path through the structure and thereby increase the hazard of failure by piping. Additional studies would be required to determine the effect of overtopping on the structural stability of this dam.
- b. Design and Construction Data. No design or construction data were available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.
- c. Operating Records. There are no controlled operating facilities for this dam.
- d. Post Construction Changes. The inspection team is not aware of any post construction changes on this dam.
- e. Seismic Stability. This dam is located in Seismic Zone 1. An earthquake of the magnitude predicted in this area might cause structural failure of this dam. This conclusion is based upon the height, steepness of downstream slope, present seepage conditions and apparent low strength of saturated abutment materials.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

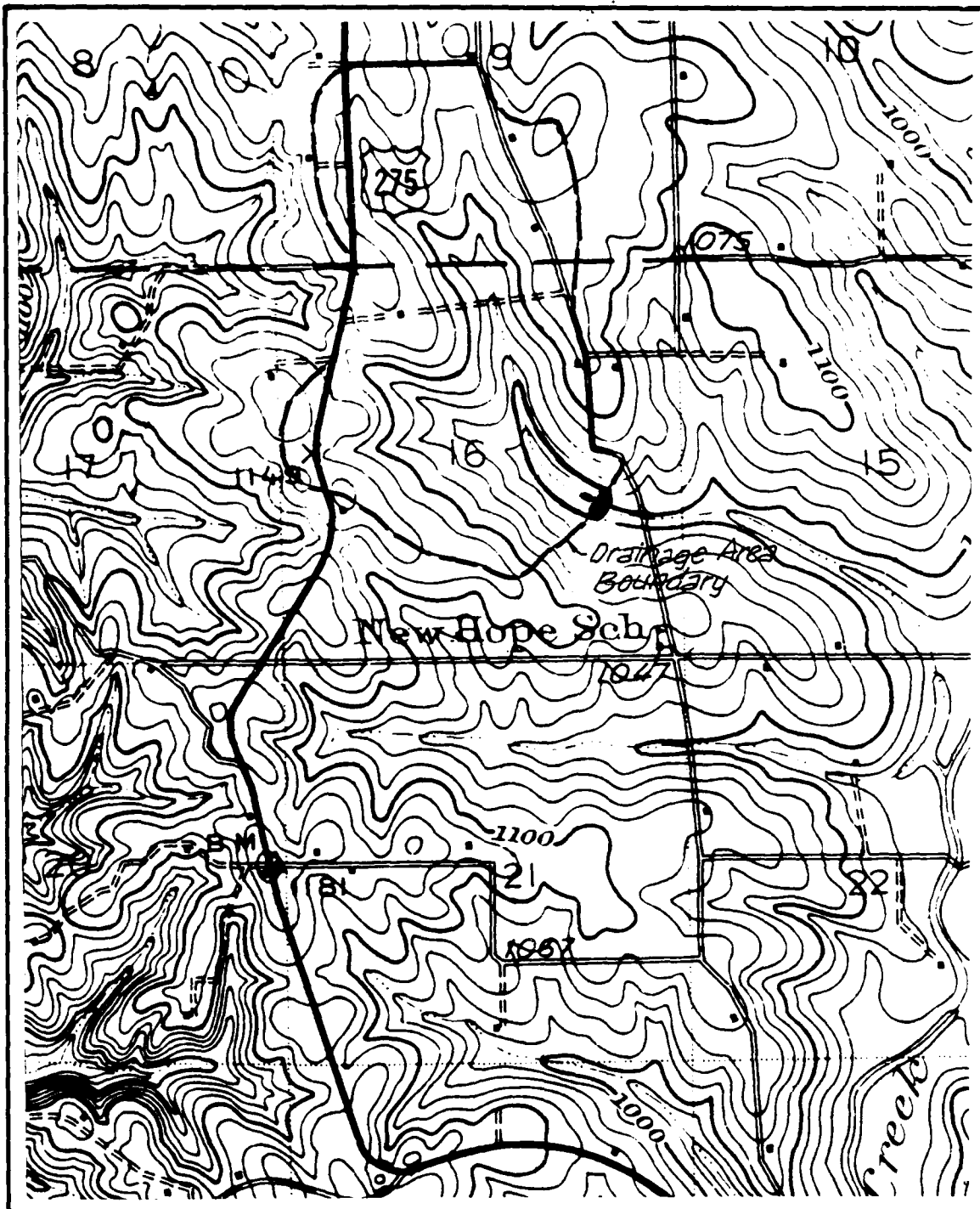
- a. Safety. Floods caused by 15% of the Probable Maximum Flood will overtop the dam. It is felt that such overtopping would have a detrimental effect upon the structural and erosional stability of the dam and the emergency spillways. Seepage on the downstream slope and the instability of the left downstream abutment indicate potential of failure under maximum loading conditions. Potential of failure by piping under full reservoir head is enhanced by the presence of rodent holes, the sink hole and surface gullies. Significant flows through the left emergency spillway could cause potential of failure by breaching the dam.
- b. Adequacy of Information. Due to the lack of engineering data, the conclusions in this report are based upon performance history and visual observations. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency.
- c. Urgency. The items recommended in paragraph 7.2 should be pursued on a high priority basis.
- d. Necessity for Phase II. Phase II investigation is not considered necessary.
- e. Seismic Stability. This dam is located in Seismic Zone 1. An earthquake of this magnitude might cause potential of failure of this dam in its present condition.

7.2 REMEDIAL MEASURES

- a. Alternatives. Additional information should be obtained on the topographic characteristics of the reservoir area to determine the increase in the height of dam or the size of the spillway that is necessary to pass one half the Probable Maximum Flood without overtopping the dam. The services of an engineer experienced in the design and construction of dams should be obtained to evaluate the present reservoir storage capacity, to provide seepage and stability analyses of the present dam, and to design protective measures.

- b. O & M Procedures. The following deficiencies in maintenance should be corrected.
- (1) Trees and shrubs growing on the dam should be removed and measures taken to prevent their recurrence. Removal should be under the guidance of an engineer experienced in the design and construction of earthen dams.
 - (2) Rodent holes on the upstream slope, the sink hole in the left emergency spillway, and erosional gullies on the downstream slope should be repaired. Repair of these items should be done under guidance of a qualified engineer.
 - (3) The channel downstream from the principal spillway outlet should be cleared of sufficient trees and debris to allow free flow of the pipe spillway. This should allay the scour hole erosion along the right abutment and channel bank.
 - (4) Measures should be taken to stabilize and maintain abutment slopes downstream from the left end of the dam.
 - (5) A schedule of regular inspection and maintenance should be initiated to prevent and/or repair tree growth and rodent holes on the dam, scour hole erosion, and abutment slope stability.

APPENDIX A
MAPS



Scale in feet
2000 1000 0 2000 4000

Contour Interval 20 Feet



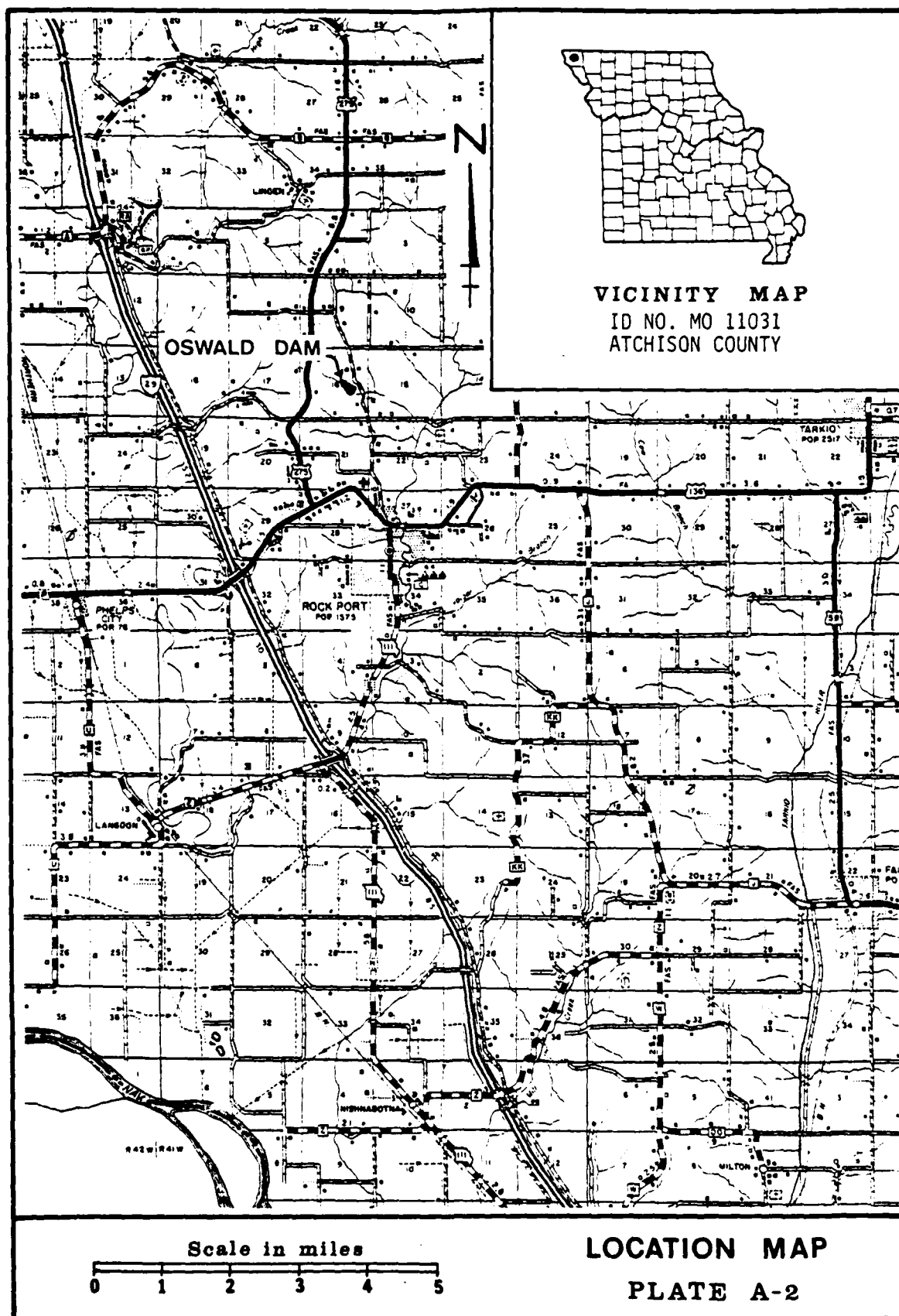
VICINITY TOPOGRAPHY

OSWALD DAM

ATCHISON COUNTY, MISSOURI

MO. 11031

PLATE A-1



APPENDIX B
PHOTOGRAPHS

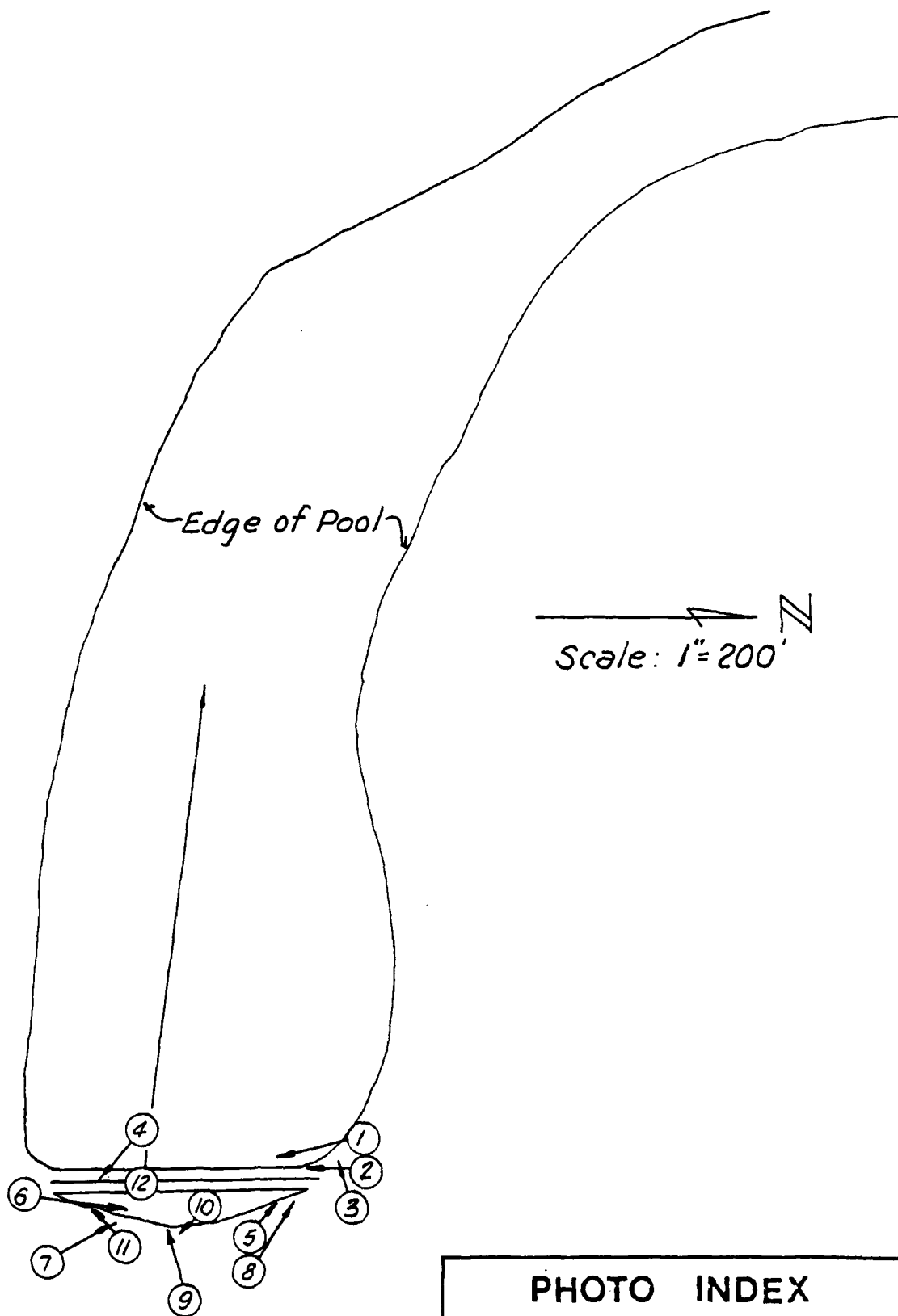


PHOTO INDEX

OSWALD DAM

ATCHISON COUNTY, MISSOURI

MO. 11031

PLATE B-1



PHOTO NO. 2 - UPSTREAM SLOPE AND CREST FROM LEFT ABUTMENT.

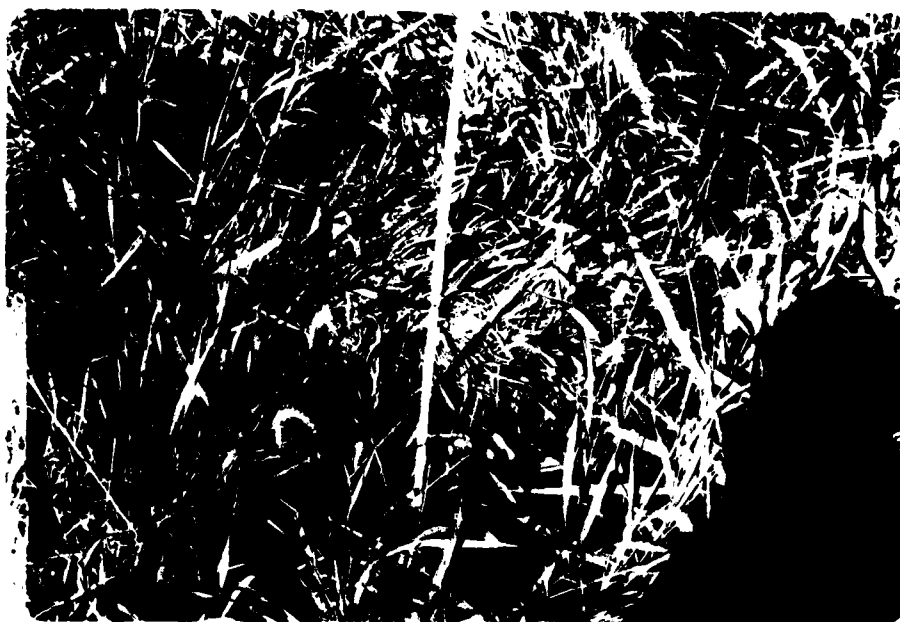


PHOTO NO. 3 - SINK HOLE IN ENTRANCE OF LEFT EMERGENCY SPILLWAY.



PHOTO NO. 4 - RODENT HOLES IN UPSTREAM FACE.

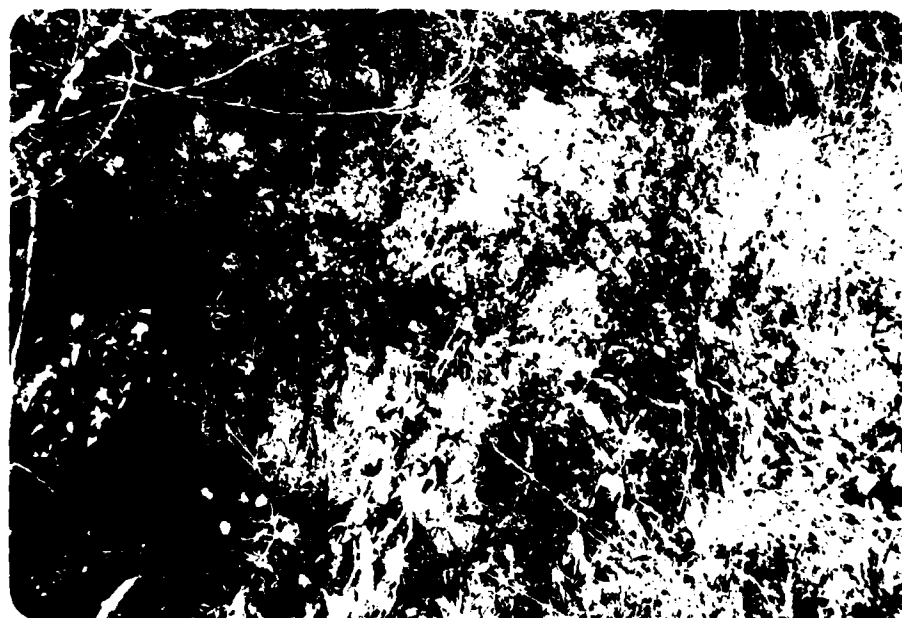


PHOTO NO. 5 - SEEP AREA, DOWNSTREAM LEFT ABUTMENT TROUGH.



PHOTO NO. 6 - DOWNSTREAM SLOPE FROM RIGHT ABUTMENT.

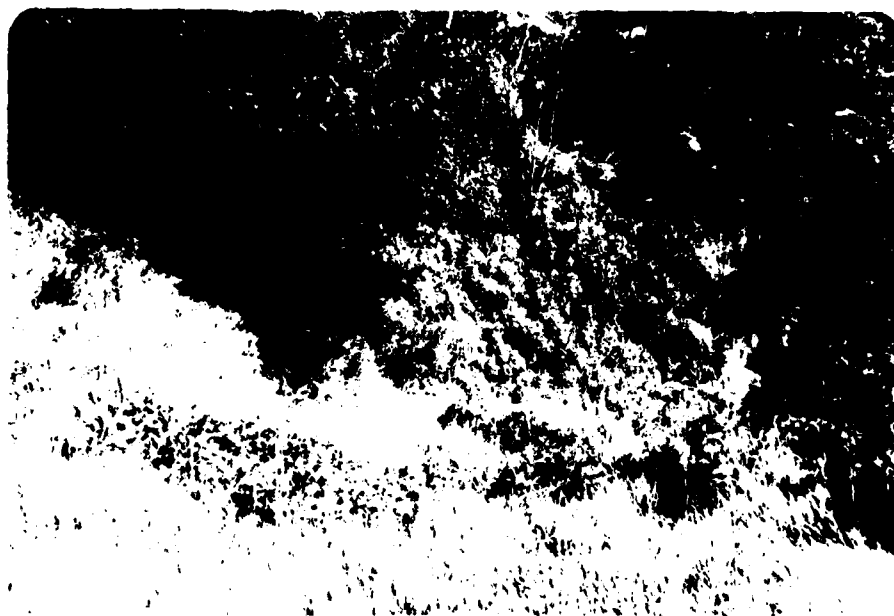


PHOTO NO. 7 - DOWNSTREAM SLOPE LOOKING UPSTREAM FROM RIGHT.



PHOTO NO. 8 - ERODING SLOPES AND SLUMPS IN LEFT DOWNSTREAM ABUTMENT.



PHOTO NO. 9 - SLUMP ON LEFT SIDE OF PRINCIPAL SPILLWAY EXIT.



PHOTO NO. 10 - OUTLET END OF PRINCIPAL SPILLWAY. BADLY
CHOKED AND ERODING STILLING BASIN.

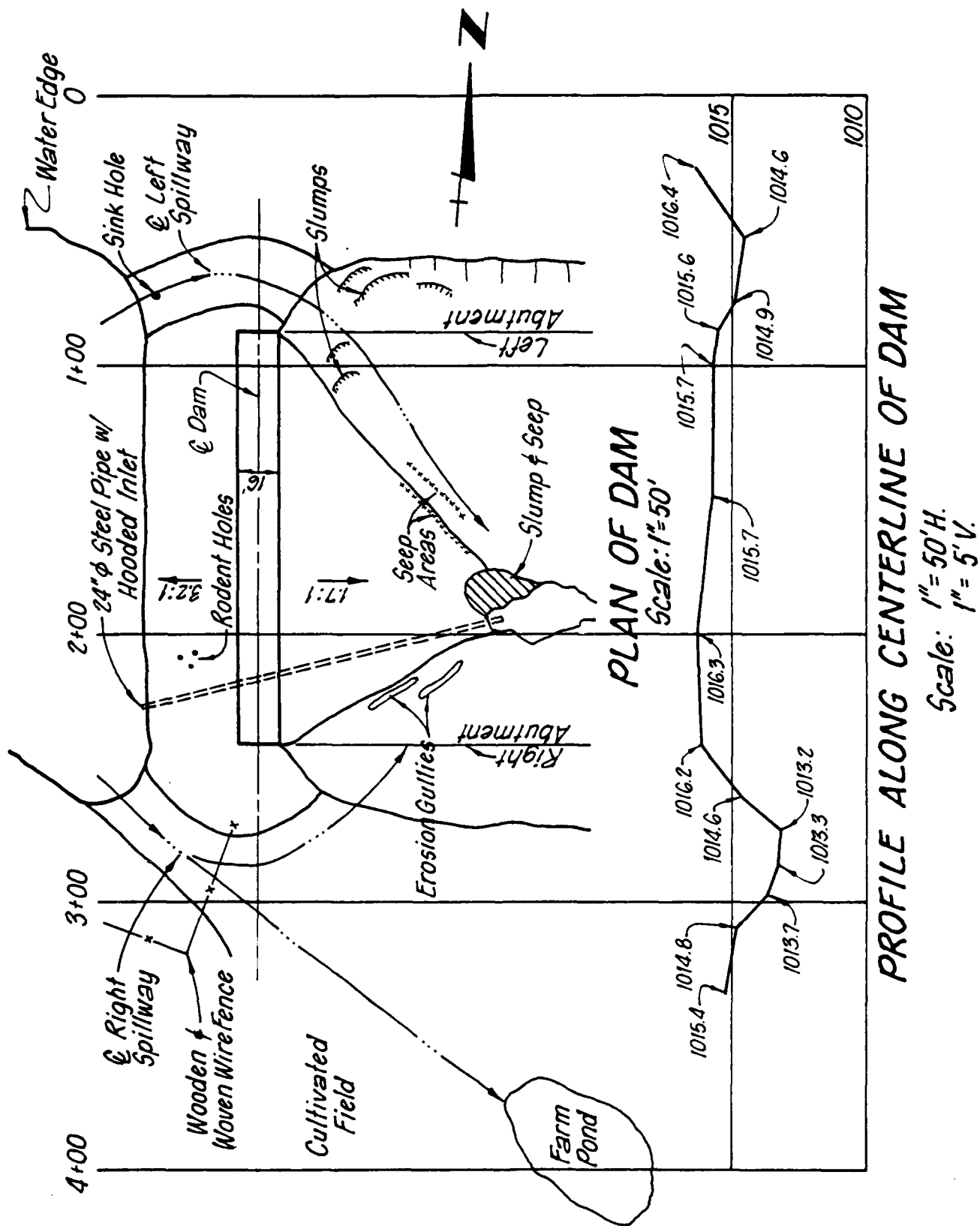


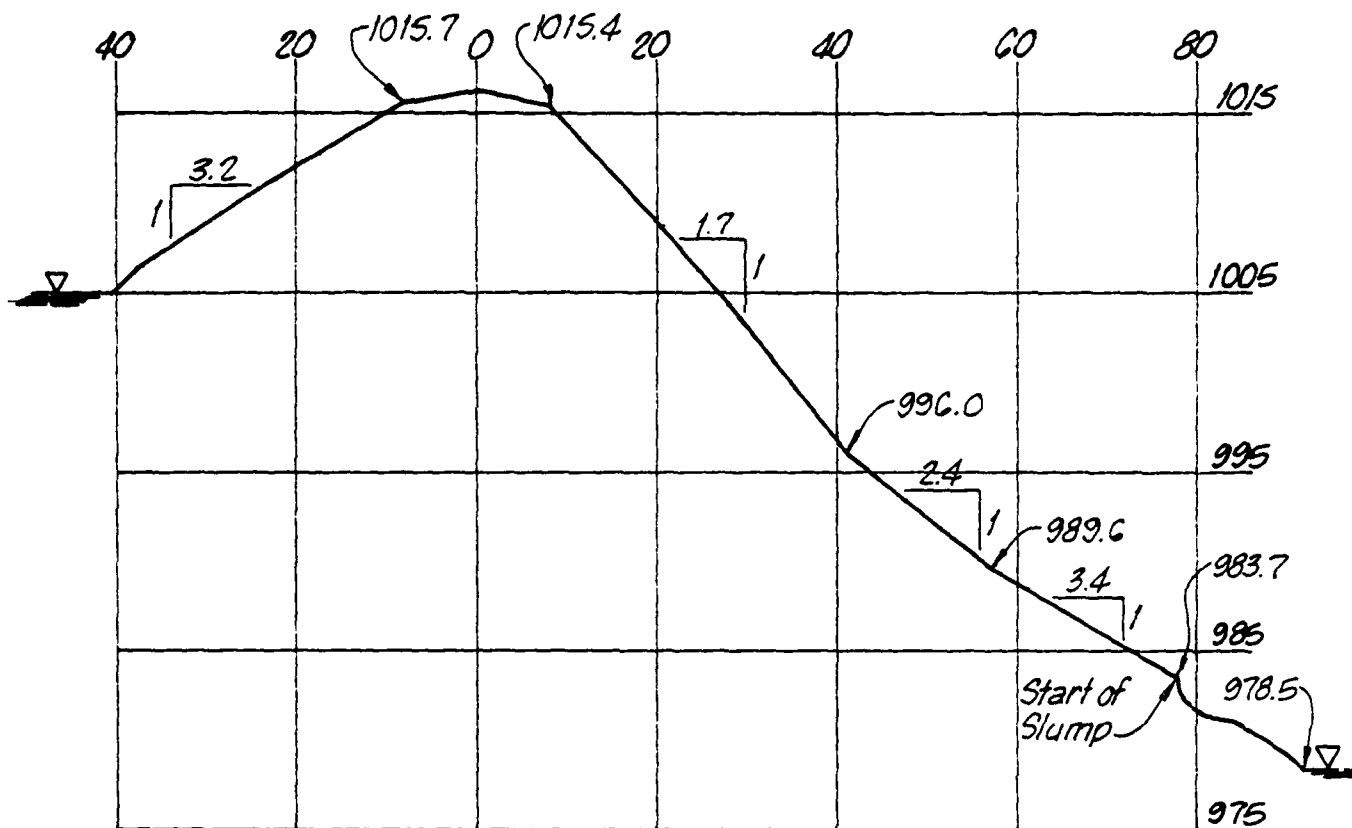
PHOTO NO. 11 - GULLY IN RIGHT DOWNSTREAM ABUTMENT TROUGH.



PHOTO NO. 12 - LOOKING UPSTREAM FROM CREST.

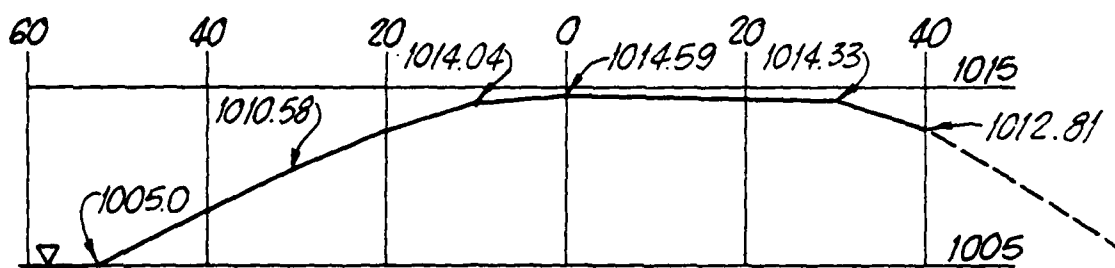
APPENDIX C
PROJECT PLATES





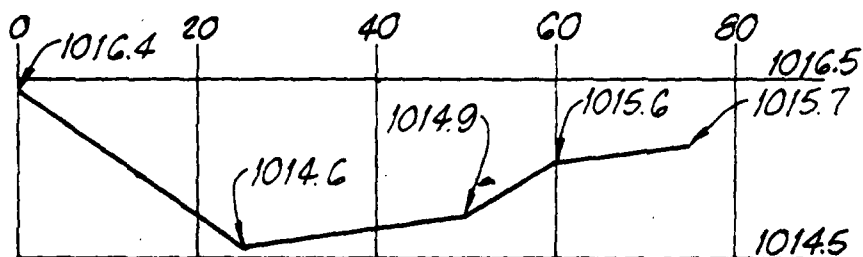
SECTION @ STA. 1+70

Scale: 1" = 20' H.
1" = 10' V.



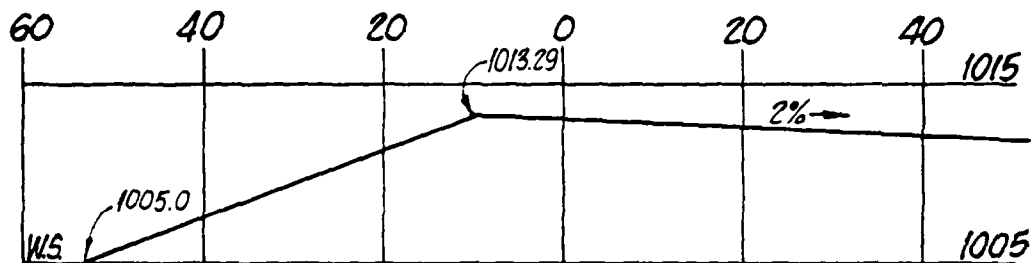
Q PROFILE OF LEFT SPILLWAY

Scale: 1" = 20' H, 1" = 10' V.



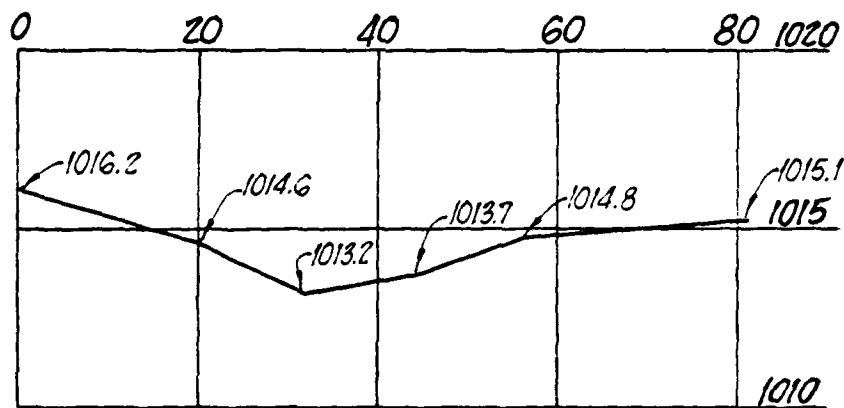
LEFT SPILLWAY SECTION (E of DAM)

Scale: 1" = 20' H.
1" = 2' V.



§ PROFILE OF RIGHT SPILLWAY

Scale: 1" = 20' H.
1" = 10' V.



RIGHT SPILLWAY SECTION (E OF DAM)

Scale: 1" = 20' H.
1" = 5' V.

APPENDIX D
HYDRAULIC AND HYDROLOGIC DATA

HYDROLOGIC COMPUTATIONS

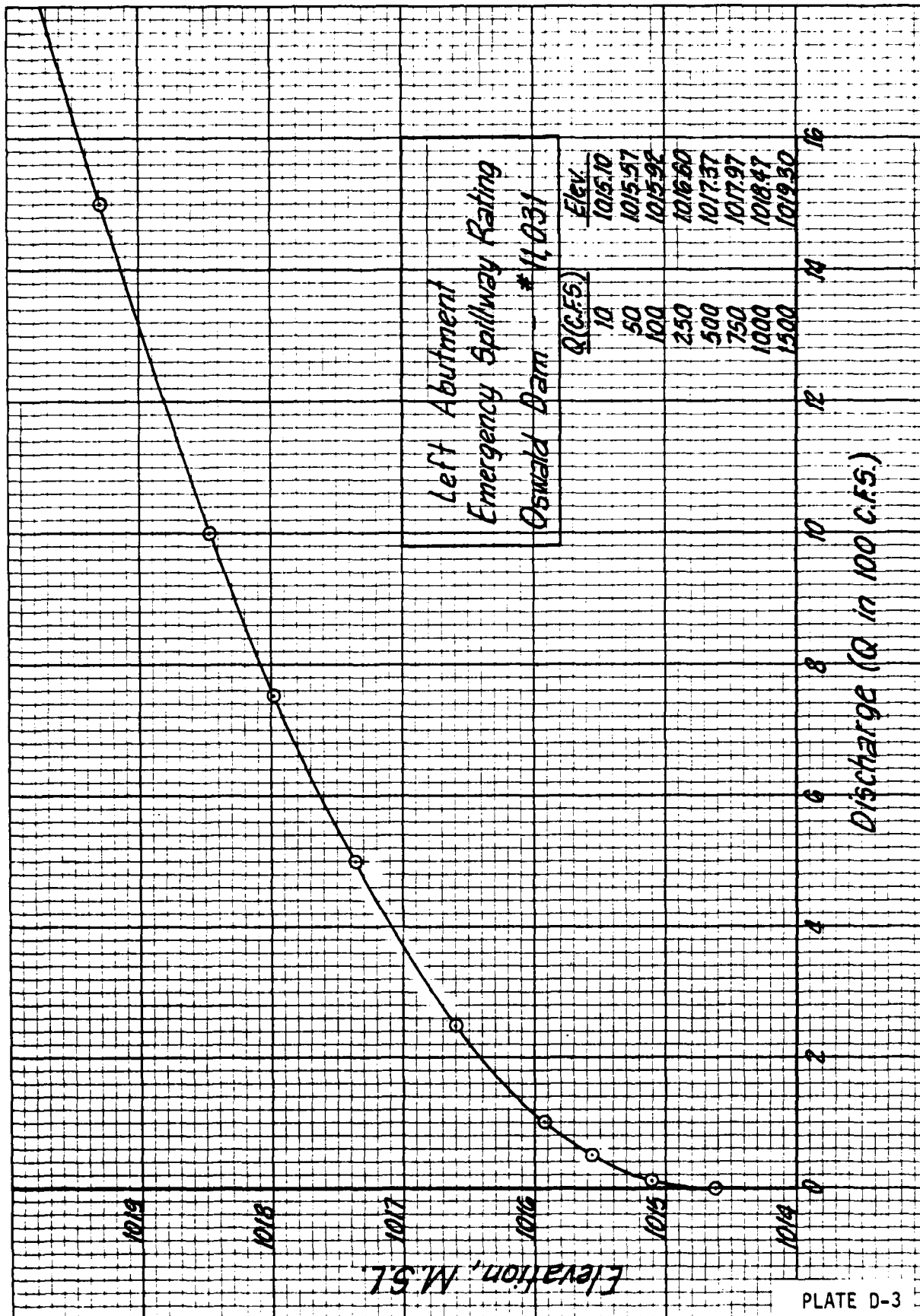
1. The SCS dimensionless unit hydrograph and the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Corps of Engineers, Davis, California, were used to develop the inflow hydrographs.
 - a. Twenty-four hour, 100-year and 10-year rainfall for the dam location were taken from the data for the rainfall station at Maryville, MO as supplied by the St. Louis District, Corps of Engineers per their letter dated 6 March 1979. The twenty-four hour probable maximum precipitation was taken from the curves of Hydrometeorological Report No. 33 and current Corps of Engineers and St. Louis policy and guidance for hydraulics and hydrology.
 - b. Drainage area - 0.79 square miles (507 acres).
 - c. Time of concentration of runoff - 30 minutes (computed from "Kirpich" formula).
 - d. The antecedent storm conditions for the probable maximum precipitation were heavy rainfall and low temperatures which occurred on the previous 5 days (SCS AMC III). The antecedent storm conditions for the 100-year and 10-year precipitation were an average of the conditions which have preceded the occurrence of the maximum annual flood on numerous watersheds (SCS AMC II). The initial pool elevation was assumed at the invert of the principal spillway.
 - e. The total twenty-four hour storm duration losses for the 100-year storm were 2.64 inches. The total losses for the PMF storm were 1.43 inches. These data are based on SCS runoff curve No. 89 and No. 77 for antecedent moisture conditions SCS AMC III and AMC II respectively. The watershed is composed of SCS soil group B (Marshall, Judson, Kennebec soils) and consists mostly of cropland with some of the watershed in pasture.
 - f. Average soil loss rates - 0.06 inch per hour approximately (for PMF storm, AMC III).
2. The combined discharge rating consisted of three components: the flow through the principal spillway, the flow through the emergency spillways and the flow going over the top of the dam.

- a. The principal spillway rating was developed using the full flow equation:

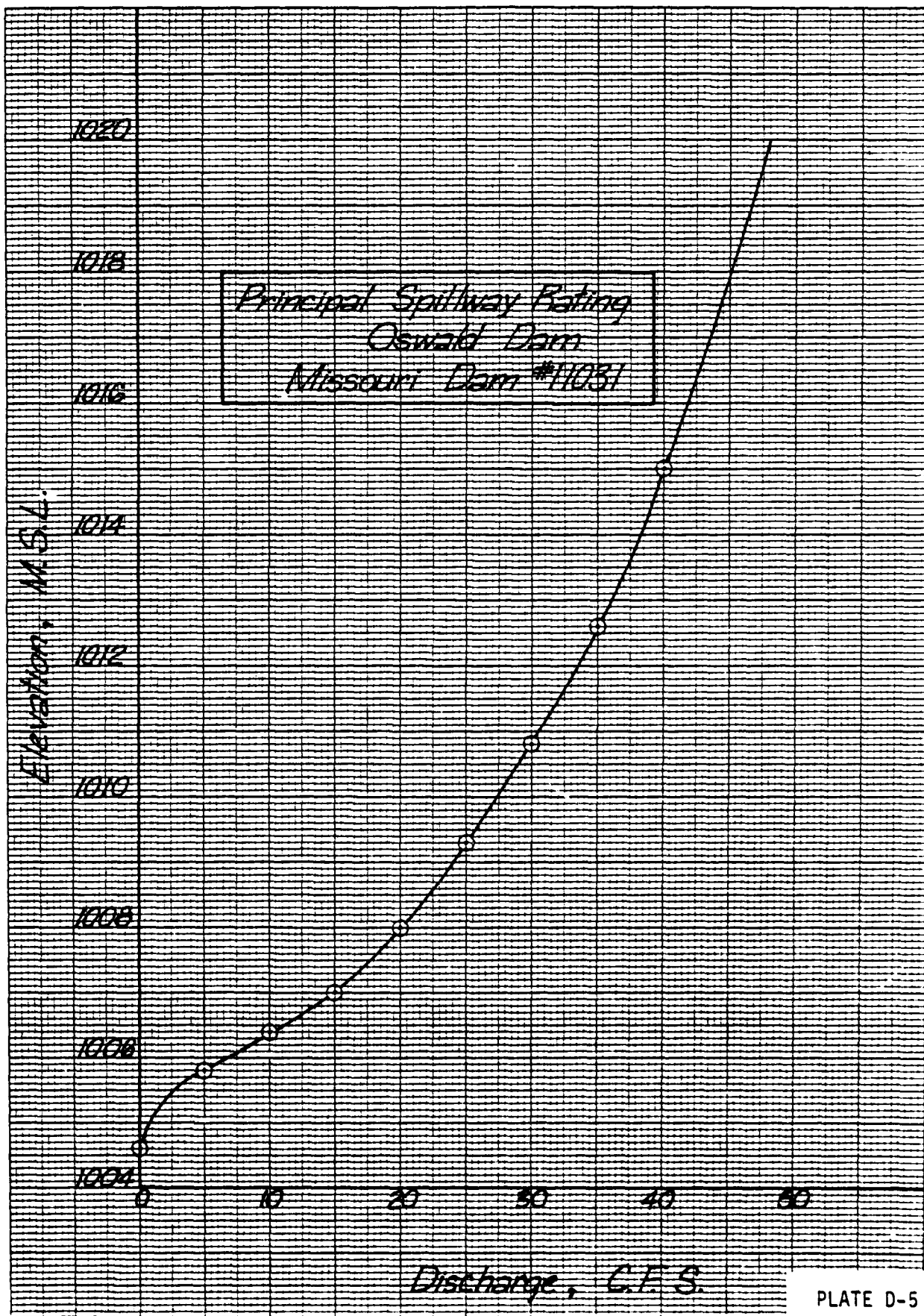
$$(Q = a \sqrt{\frac{2gH}{1 + K_e + K_b + K_p L}})$$

where a = cross-sectional area of pipe, $\text{ft}^2 = 3.14$
 H = total head, ft.
 K_e = coefficient for entrance loss = 0.5
 K_b = coefficient for bend loss = 0
 K_p = coefficient for pipe friction loss = 0.00735
 L = length of pipe, ft. = 133

- b. The emergency spillway ratings for the left and right spillways were developed using the Corps of Engineers Surface Water Profile HEC-2 computer program. The coefficient of roughness for the right spillway was adjusted to reflect the wooden fence which crosses the spillway.
- c. The flows over the dam were developed using the dam overtopping analysis (Flow over non-level dam crest) within the HEC-1 (Dam Safety Version) program.
3. Floods were routed through the reservoir using the HEC-1 (Dam Safety Version) program to determine the capabilities of the spillway and dam embankment crest.







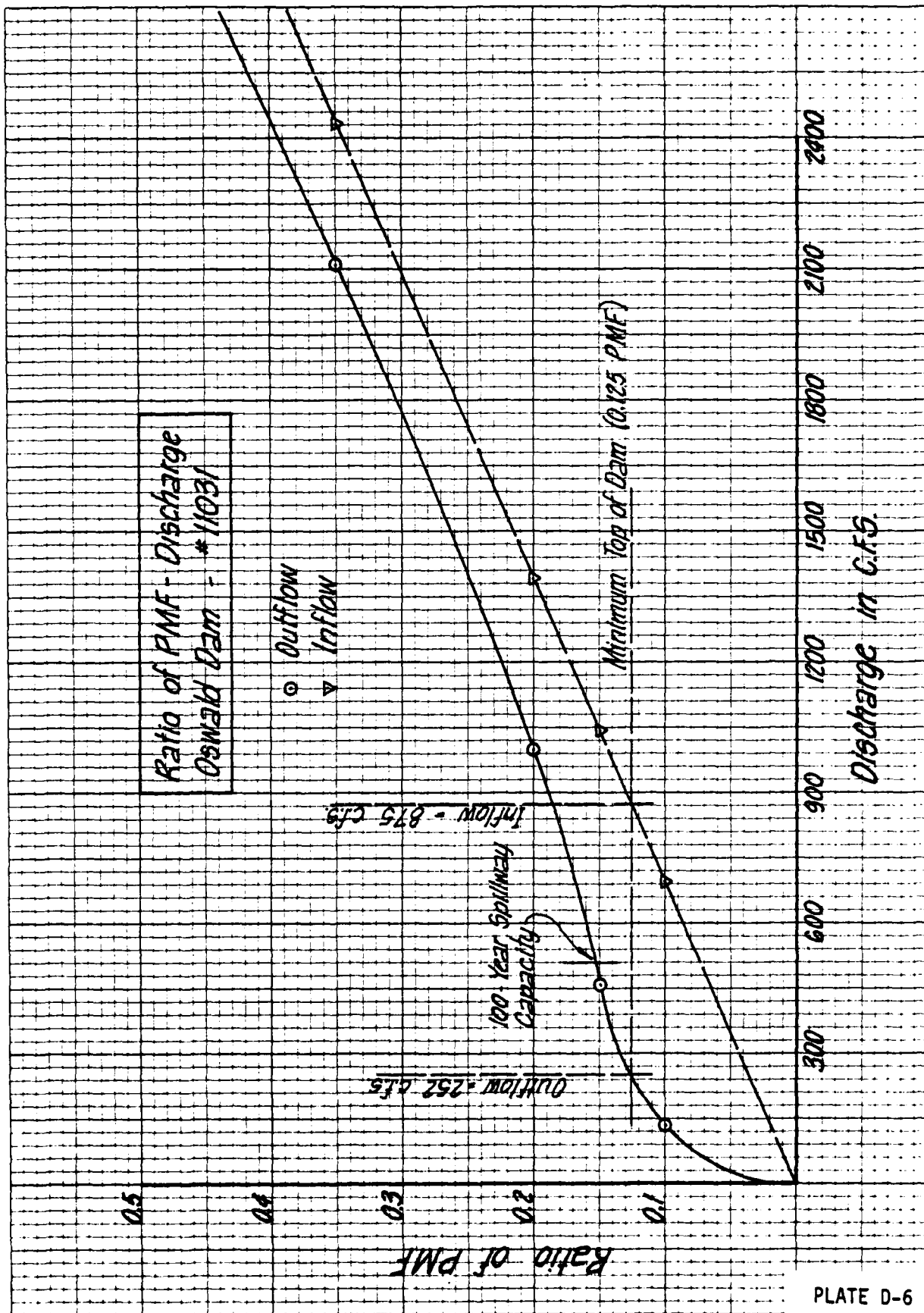


PLATE D-6

PMF Output

Data

 FLUID HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VER. 10.1 JULY 1978
 LAST MODIFICATION 26 FEB 79

RUN DATE= 7/20/79
 TIME= 11.23.16

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
 HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF USVALD DAM 11031
 RATIOS OF PMF ROUTED THRU THE RESERVOIR

JOB SPECIFICATION									
NO	NHR	AMIN	LDAY	THR	IMIN	METRC	IPRT	IPRI	ISTAN
288	0	5	0	0	0	0	0	5	0
		JUPER	NMI	LROPT	TRACE				
		5	0	0	0				

MULTI-PLAN ANALYSES TO BE PERFORMED

RTIUS= .10 .15 .20 .35 .50 1.00
 NPLAN= 1 NRTIU= 6 LRIO= 1

SUB-AREA RUNOFF COMPUTATION

CALCULATION OF INFLOW HYDROGRAPH TO 11031 RES

ISTAQ	ICOMP	TECON	ITAPE	JULI	JPRI	INAME	ISAGE	IAUTO
CG0001	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

INYDC	IUMG	IARLA	SNAP	IRSDA	IRSPC	RATIO	ISNUM	ISAME	LOCAL
1	2	.79	0.00	.79	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.60	102.00	121.00	130.00	0.00	0.00	0.00

LOSS DATA

LROPT	STKR	DLTR	RTUL	ERATH	STRS	RTOK	STRL	CRSL	ALSPX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-89.00	0.00	0.00

CURVE NO = -89.00 WEIRNESS = -1.00 EFFECT CN = 89.00

UNIT HYDROGRAPH DATA

TC= 0.00 LAG= .30

RECESSION DATA

STRTD= 0.00 ORCSH= -.01 RTIER= 1.00

UNIT HYDROGRAPH 20 END OF PERIOD ORIGINATES, TC= 0.00 HOURS, LAG= .30 VOL= 1.00									
157.	506.	960.	1121.	1024.	605.	511.	442.	235.	156.
106.	71.	47.	32.	22.	15.	10.	7.	4.	1.

END-OF-PERIOD FLOW

0

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 4									
PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME					
190.	401.	124.	124.	35796.					
CFS									
39.	11.	4.	4.	1014.					
CMS									
INCHES									
	119.60	148.13	148.13	148.13					
AC-FT	199.	247.	247.	247.					
THOUS CU M	246.	304.	304.	304.					
HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 5									
PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME					
2432.	702.	218.	218.	62643.					
CFS									
69.	20.	6.	6.	1774.					
CMS									
INCHES									
	8.24	10.21	10.21	10.21					
AC-FT	207.29	259.23	259.23	259.23					
THOUS CU M	348.	431.	431.	431.					
	439.	532.	532.	532.					
HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 6									
PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME					
3475.	1003.	311.	311.	89430.					
CFS									
98.	28.	9.	9.	2534.					
CMS									
INCHES									
	11.77	14.58	14.58	14.58					
AC-FT	298.99	370.33	370.33	370.33					
THOUS CU M	498.	616.	616.	616.					
	614.	760.	760.	760.					
HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 6									
PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME					
6949.	2007.	621.	621.	178930.					
CFS									
197.	57.	18.	18.	5068.					
CMS									
INCHES									
	23.54	29.16	29.16	29.16					
AC-FT	577.98	740.67	740.67	740.67					
THOUS CU M	995.	1233.	1233.	1233.					
	1228.	1520.	1520.	1520.					
ROUTED FLOWS THRU 11031 RES									
HYDROGRAPH ROUTING									
ISTAQ	ICOMP	TECUN	ITAPE	JPT	JPR1	INAME	ISTAGE	IAUTO	
000002	1	0	0	2	0	1	0	0	
QLOSS	CLOSS	AVG	IRCS	ISAH	IPPP	ISTR			
0.0	0.000	0.00	1	0	0	0			
MSIPS	MSIDL	IAG	AMCKK	X	TSK	STORA	ISPRAT		
1	0	0	0.000	0.000	0.000	-1005.	-1		

PLATE D-10

PLATE D-11

STATION 0000002

DATE

0.	400.	800.	1200.	1600.	2000.	2400.	2800.	3200.	3600.	0.	0.
.05											
.10											
.15											
.20											
.25											
.30											
.35											
.40											
.45											
.50											
.55											
1.00											
1.05											
1.10											
1.15											
1.20											
1.25											
1.30											
1.35											
1.40											
1.45											
1.50											
1.55											
2.00											
2.05											
2.10											
2.15											
2.20											
2.25											
2.30											
2.35											
2.40											
2.45											
2.50											
2.55											
3.00											
3.05											
3.10											
3.15											
3.20											
3.25											
3.30											
3.35											
3.40											
3.45											
3.50											
3.55											
4.00											
4.05											
4.10											
4.15											
4.20											
4.25											
4.30											
4.35											
4.40											

20.15/43.1 U
 20.20/44.1 U
 20.25/45.1 U
 20.30/46.1 U
 20.35/47.1 U
 20.40/48.1 U
 20.45/49.1 U
 20.50/50.1 U
 20.55/51.1 U
 21.00/52.1 U
 21.05/53.1 U
 21.10/54.1 U
 21.15/55.1 U
 21.20/56.1 U
 21.25/57.1 U
 21.30/58.1 U
 21.35/59.1 U
 21.40/60.1 U
 21.45/61.1 U
 21.50/62.1 U
 21.55/63.1 U
 22.00/64.1 U
 22.05/65.1 U
 22.10/66.1 U
 22.15/67.1 U
 22.20/68.1 U
 22.25/69.1 U
 22.30/70.1 U
 22.35/71.1 U
 22.40/72.1 U
 22.45/73.1 U
 22.50/74.1 U
 22.55/75.1 U
 23.00/76.1 U
 23.05/77.1 U
 23.10/78.1 U
 23.15/79.1 U
 23.20/80.1 U
 23.25/81.1 U
 23.30/82.1 U
 23.35/83.1 U
 23.40/84.1 U
 23.45/85.1 U
 23.50/86.1 U
 23.55/87.1 U
 0.00/88.1 U

PEAK FLOW AND STORAGE (EQU. 16 PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS					
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6
				.10	.15	.20	.35	.50	1.00
HYDROGRAPH AT	000001	.79 (2.05)	1	695.	1042.	1390.	2432.	3475.	6949.
				19.6811	29.5211	39.3611	68.8711	98.3711	196.7811
MINUTED TO	000002	.79 (2.05)	1	136.	459.	998.	2109.	3093.	6329.
				3.8411	13.0011	28.2711	59.7111	87.5911	179.4911

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1		ELEVATION		INITIAL VALUE		SPILLWAY CREST		TOP OF DAM	
		STORAGE		1005.00		1004.80		1015.60	
		OUTFLOW		10.		9.		104.	
				1.		1.		232.	
RATIO OF PHE	MAXIMUM RESERVOIR W.S.-ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS		
.10	1015.09	0.00	94.	136.	0.00	18.00	0.00		
.15	1016.07	.47	113.	459.	2.00	16.33	0.00		
.20	1016.65	1.05	125.	998.	2.83	16.08	0.00		
.25	1017.41	1.81	140.	2109.	4.72	16.00	0.00		
.30	1017.93	2.33	151.	3093.	6.08	16.00	0.00		
1.00	1019.44	3.84	181.	6339.	8.75	15.92	0.00		